

# CSCE 311 - S24: Exam 1 Study Guide

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## Learning Goals

This is an outline of the topics we have covered in lecture. Problems on the exam will reference these, showing why these problems were selected to test your knowledge. This outline is not complete—at a minimum, material from quizzes, homeworks, and recitations may also appear.

1. Math Background
  - (a) Logarithms
  - (b) Definition of Algorithm
  - (c) Pseudocode
  - (d) `InsertionSort` and Analysis
2. Proof Techniques
  - (a) Direct
  - (b) Contradiction
  - (c) Contrapositive
  - (d) Construction
  - (e) Cases
  - (f) Induction
3. Algorithmic Analysis
  - (a) Asymptotics:  $O, \Omega, \Theta, o, \omega$ 
    - i. Usage for upper and lower bounds
    - ii. Tight bounds ( $\Theta$ )
    - iii. Strict bounds (little-o, little-omega)
    - iv. Anonymous asymptotics
    - v. Rules for combining functions, polynomials, hierarchy
  - (b) Runtime Recurrences
    - i. Recursion Trees
    - ii. Substitution
    - iii. Master Theorem
4. Divide & Conquer
  - (a) Recursive and non-recursive parts of a D&C Algorithm
  - (b) Deriving a Runtime Recurrence
  - (c) Using a recurrence to guide algorithmic improvements (Strassen's Algorithm)